



# Update from the Silicon Task Force



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For the CDF Silicon Task Force

## Outline

- Goals, manpower and time scale
- Description of the failures:
  - ➔ Distributions
  - ➔ Symptoms
- 4 lines of investigation started
  - ➔ 1 not yet started
  - ➔ 1 ruled out
  - ➔ 1 in progress (almost ruled out)
  - ➔ 1 Still going VERY STRONG EVIDENCES THAT WE ARE IN THE RIGHT TRACK
- How are we fighting back
- What should come next
- Conclusions



# The Silicon Task Force



- Built on 09/30/2002 to cope with
    - ➔ DVDD Jumpers failure
    - ➔ DOIM Failures
    - ➔ 12 KHz L1A Limit
      - ➔ With Luminosity > 3E31 we are limiting the capabilities of CDF to acquire Physics data
  - The GOALS are:
    - ➔ Understand the role of L1A trigger rate on the failure mechanisms
      - ➔ Do we need the Limit or Not?
      - ➔ Our specifications are 50 KHz so what is going on?
    - ➔ Remove/mitigate the source/s of the failures
      - ➔ Understanding them is a tool to achieve the goals
  - The time scale:
    - ➔ By the end of October we should be done (Today is 10/31/2002)
      - ➔ We will keep working on it but 2 months is reasonable to finish the job
  - Who is involved:
    - ➔ The CDF Silicon Group
    - ➔ ESE department
    - ➔ Old SVXers
    - ➔ + More (T.D. etc...)
- [www- cdf . f nal. gov/ upgrades/ silicon/ TASK- Force/ main. ht ml](http://www-cdf.fnal.gov/upgrades/silicon/TASK-Force/main.html)



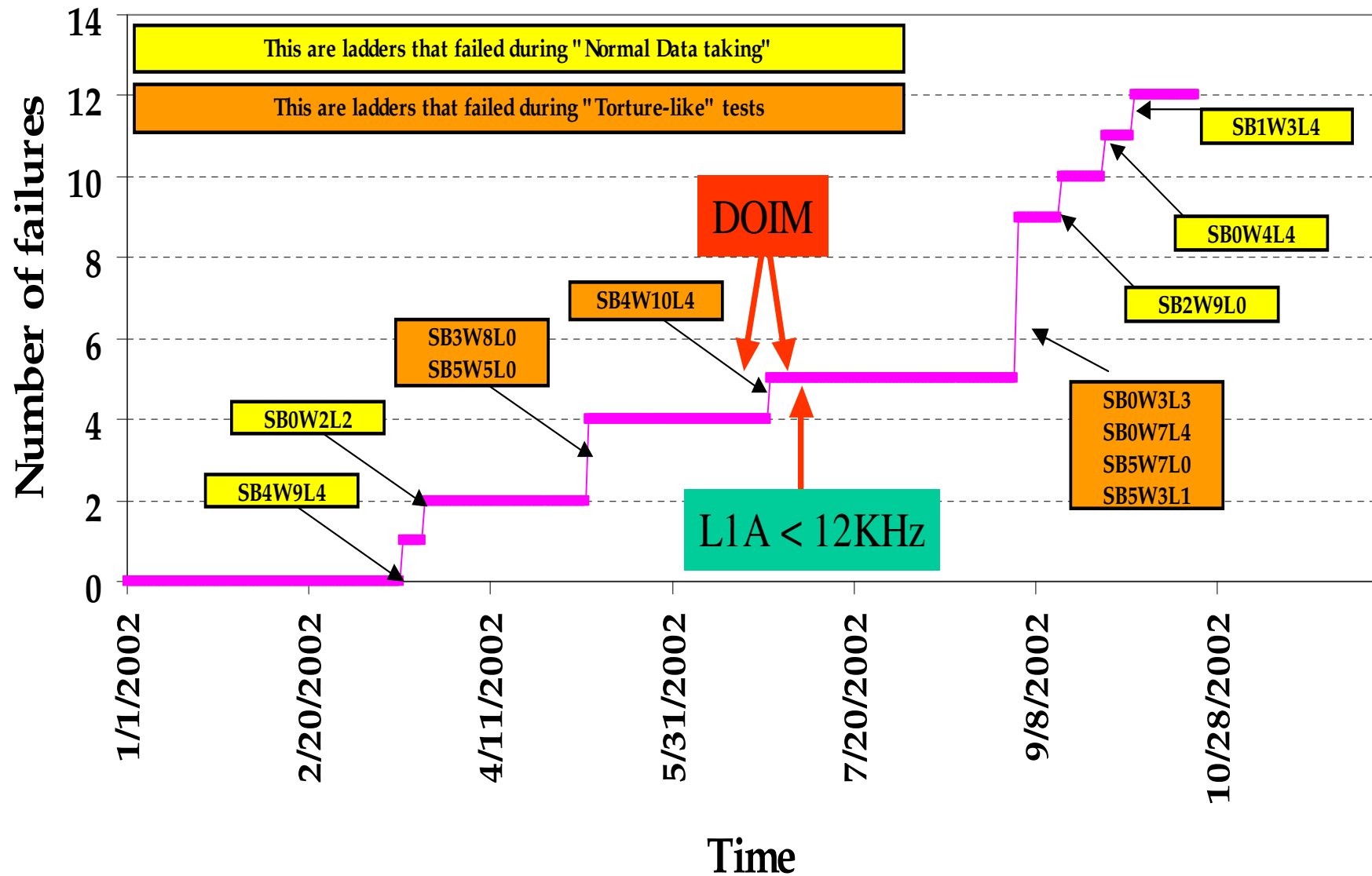
## List of failures



Ladder	Date	Type	Run	L1A rate	“Torture”
SB4W9L4	03/18/2002	Jumper	<a href="#"><u>141190</u></a>	3.4 KHz	NO
SB0W2L2	03/24/2002	Jumper	<a href="#"><u>141571</u></a>	3.5 KHz	NO
SB5W5L0	05/08/2002	Jumper	<a href="#"><u>144562</u></a>	16 KHz	YES
SB3W8L0	05/08/2002	Jumper	<a href="#"><u>144562</u></a>	16 KHz	YES
SB5W4L2	06/16/2002	DOIM	<a href="#"><u>146652</u></a>	17 KHz	YES
IB1W1L4	06/27/2002	DOIM	<a href="#"><u>147267</u></a>	16 KHz	YES
SB4W10L4	06/27/2002	Jumper	<a href="#"><u>147267</u></a>	16 KHz	YES
SB0W3L3	09/03/2002	Jumper	<a href="#"><u>150948</u></a>	5-7 KHz	YES
SB5W7L0	09/03/2002	Jumper	<a href="#"><u>150948</u></a>	5-7 KHz	YES
SB0W7L4	09/03/2002	Jumper	<a href="#"><u>150948</u></a>	5-7 KHz	YES
SB5W3L1	09/03/2002	Jumper	<a href="#"><u>150948</u></a>	5-7 KHz	YES
SB2W9L0	09/15/2002	Jumper	<a href="#"><u>151557</u></a>	3-4 KHz	NO
SB0W4L4	09/27/2002	Jumper	<a href="#"><u>152125</u></a>	3-4 KHz	NO
SB1W3L4	10/5/2002	Jumper	<a href="#"><u>152515</u></a>	7-8 KHz	NO



# Time Evolution





# Jumpers: Phi vs Z map



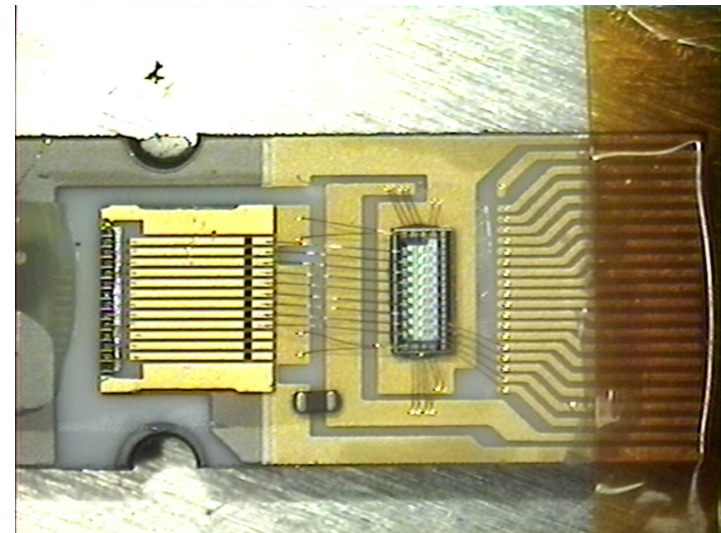
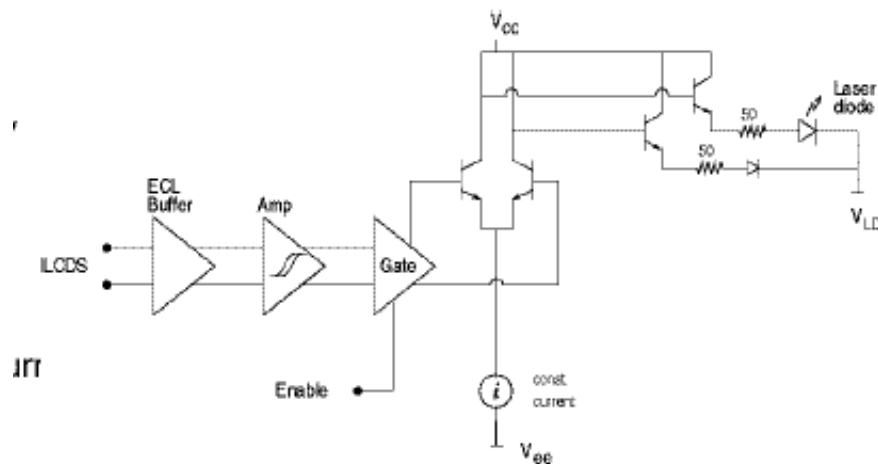
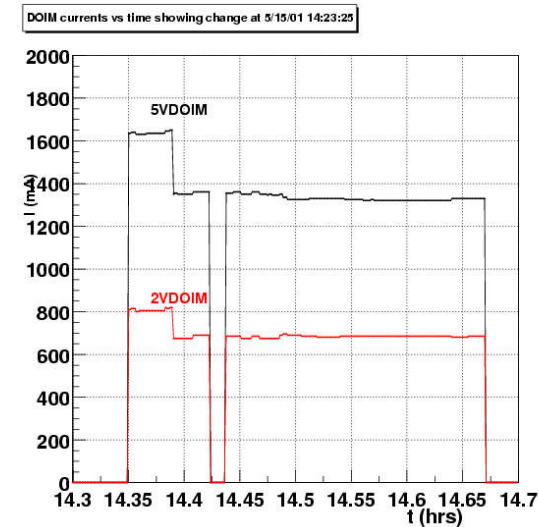
		Bulkhead					
		0	1	2	3	4	5
W	1						
E	2	L2					
D	3	L3	L4				L1
G	4	L0					
E	5						L0
	6						
	7	L4					L0
	8				L0		
	9			L0		L4	
	10					L4	
	11						



# Symptoms: DOI M FAILURE



- Consistent with loosing connection on a power line
  - 5VDOIM current decrease by 300mA (150mA)
  - 2VDOIM current decrease by 150mA
- There are NO MORE useful data coming out of the ladder (Both PHI and Z)

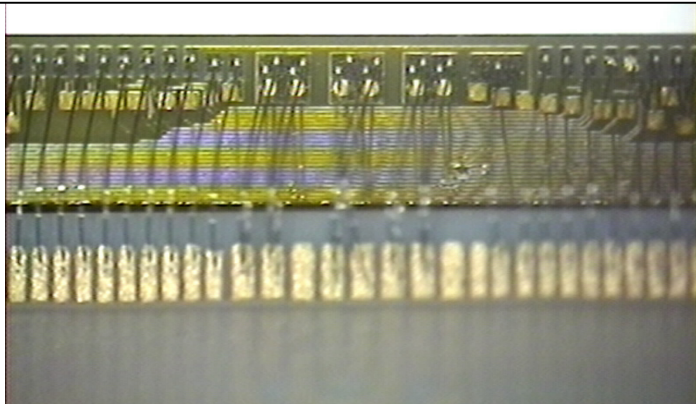




# Symptoms: Jumper FAILURE



- Consistent with loosing connection on the DVDD power line
  - ➔ Increase of AVDD current
    - ➔ Understood now with the help of Tom Zimmerman
  - ➔ Decrease of DVDD current (almost negligible)
- NO MORE useful data coming out of Z side of the ladder (the PHI side is still fully functioning)



7f008214 00010100

..... . . . .

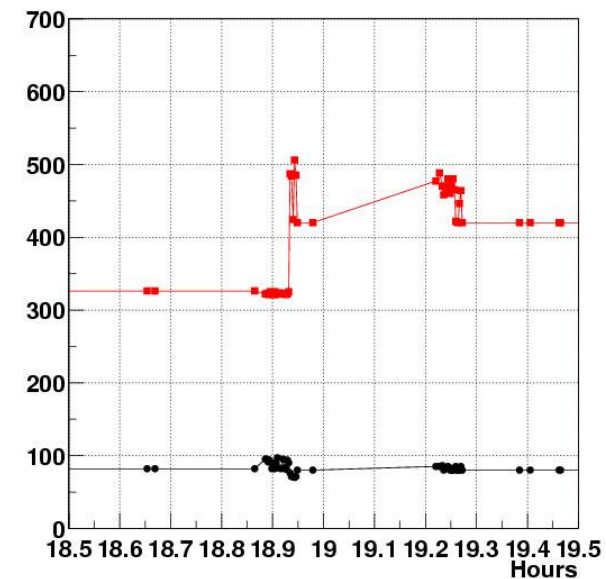
70067100 72027304

74077500 76007704

78047903 7a007b00

7c077d00 7e007f04

a1140000 a0140001





# What is being done:



## 4 Lines of investigation

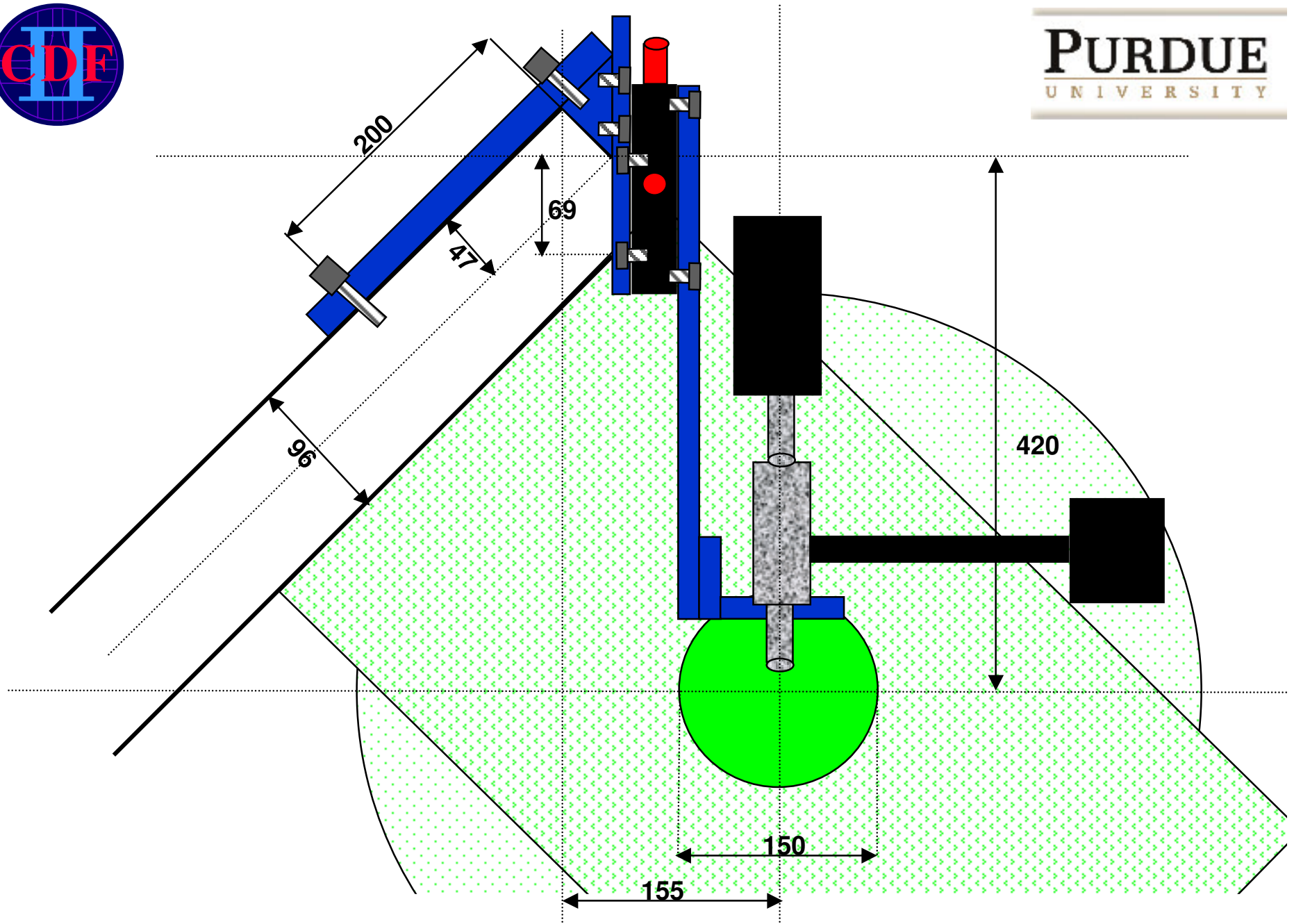
- ➔ **Breaking the power connections due to excess current:**
  - ➔ Not possible without tripping the Power Supply
  - ➔ **At this time considered closed**

[www-cdf.fnal.gov/internal/silicon/TASK-Force/Line1.PDF](http://www-cdf.fnal.gov/internal/silicon/TASK-Force/Line1.PDF)
- ➔ **Aging of the power connections**
  - ➔ Test still running (4 days at 90 deg C with 500 mA with 48 connections under test without any failure yet after ~2-3 years equivalent of CDF time)
  - ➔ Thanks to Azizur, Joel and Maurice **At this time considered almost closed**

[www-cdf.fnal.gov/internal/silicon/TASK-Force/line2/line2.html](http://www-cdf.fnal.gov/internal/silicon/TASK-Force/line2/line2.html)
- ➔ **Aging of the power connection induced by Lorentz forces**
  - ➔ Jumpers and DOIMs have power connection wire-bonds that are orthogonal to the magnetic field (even AVDD2 bonds are oriented this way)
  - ➔ 2 tests being done
    - ➔ Detailed investigation of movements vs frequency, current swings and bond shapes
      - ➔ **At the Technical division**
    - ➔ Statistic test (multi-bonds) on pull strength and failure statistic
      - ➔ **Here in CDF with the 2T TOF magnet**
  - ➔ We are breaking bonds in a systematic way and we are learning more in a daily basis

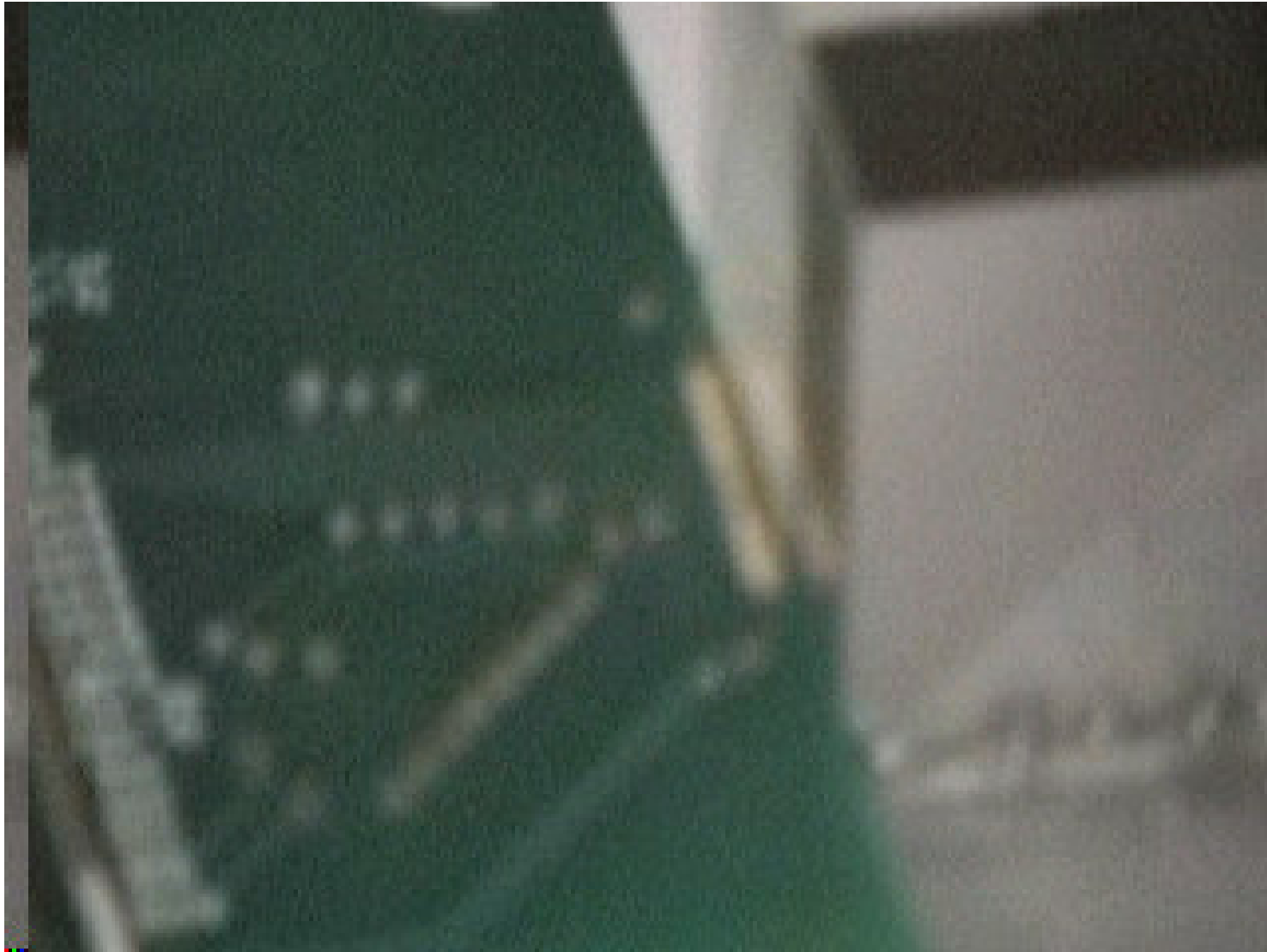
[www-cdf.fnal.gov/internal/silicon/TASK-Force/line3/line3.html](http://www-cdf.fnal.gov/internal/silicon/TASK-Force/line3/line3.html)
- ➔ **Bad grounding scheme responsible for power surges**
  - ➔ Not much done yet. (One e-mail from M. Lindgren)





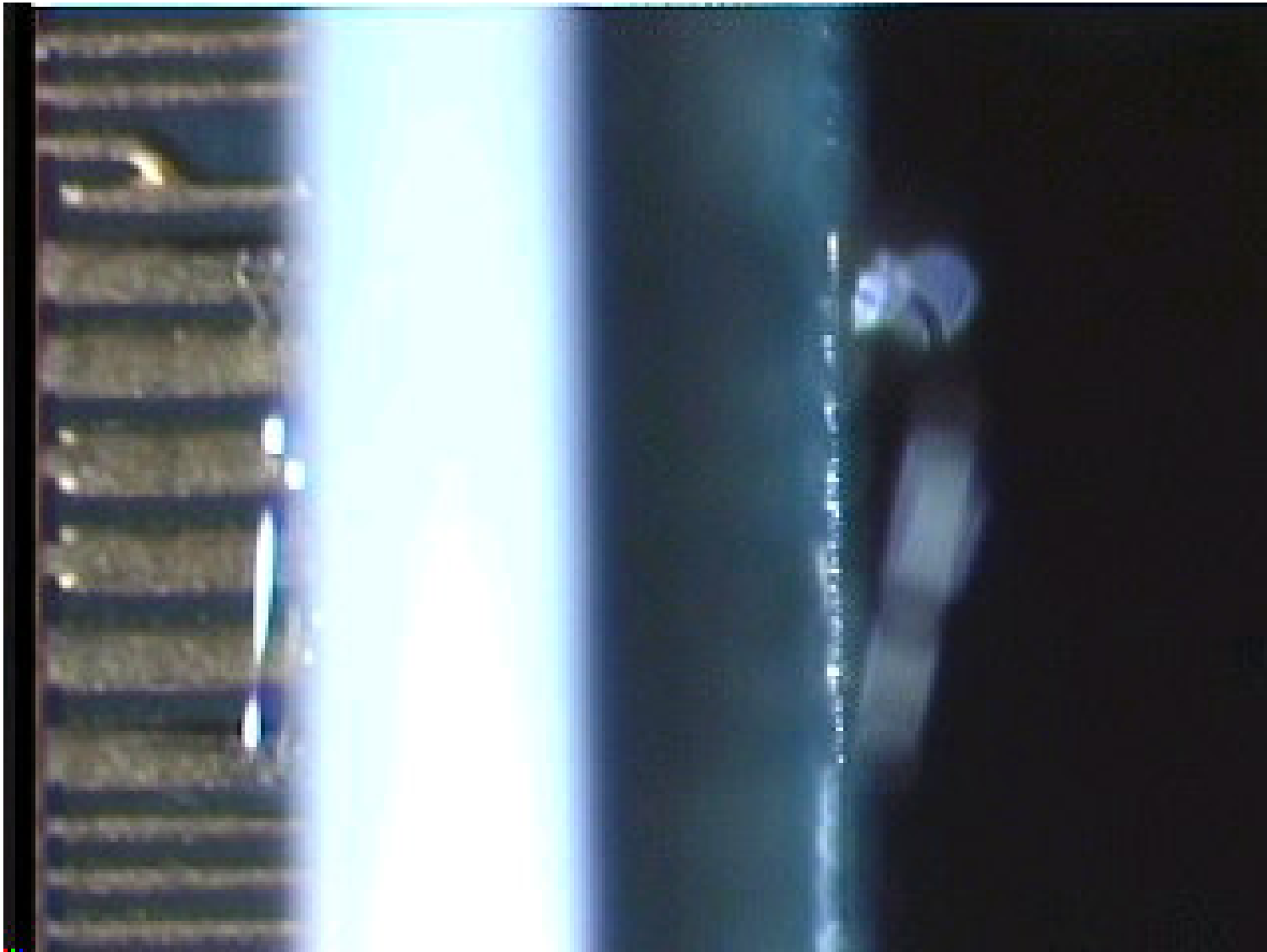


## The set up at the T.D.



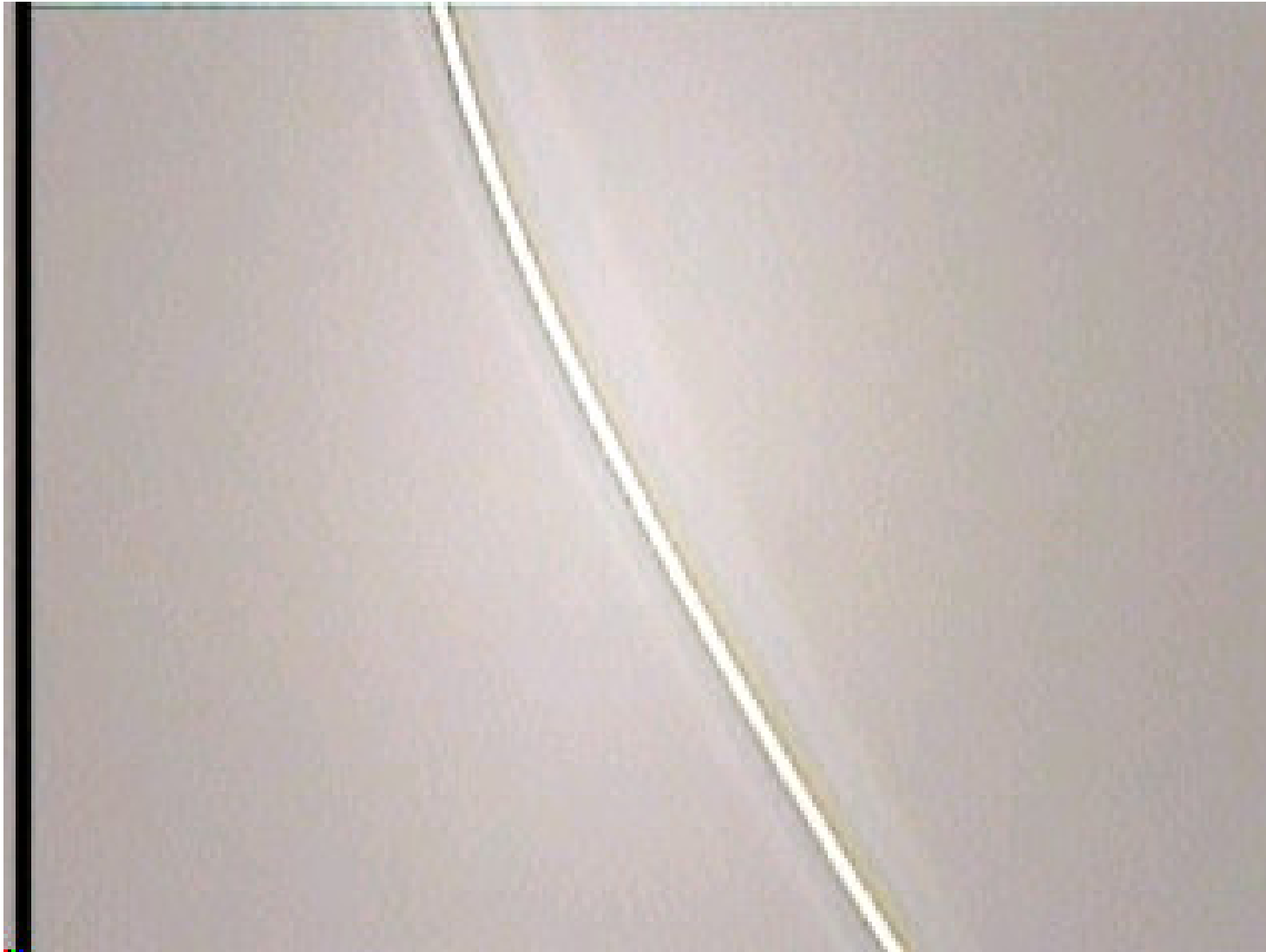


## Capabilities of the optics



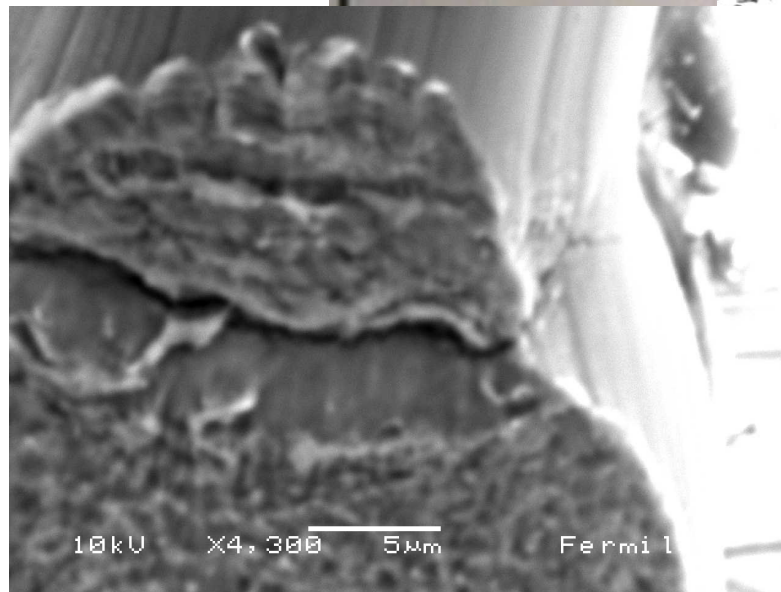
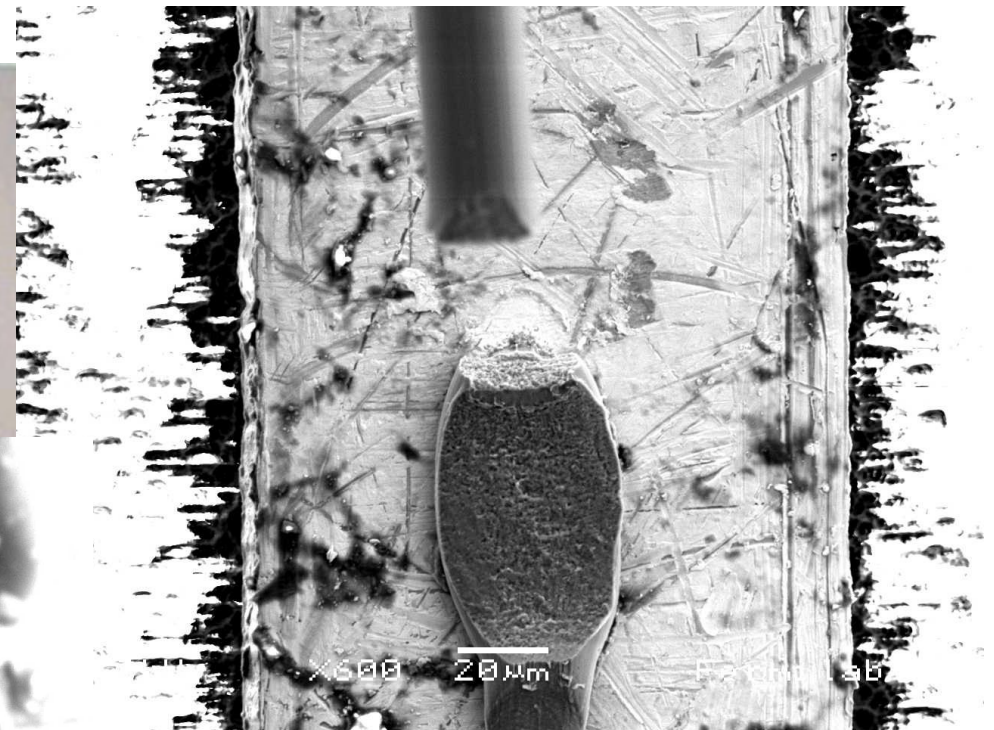
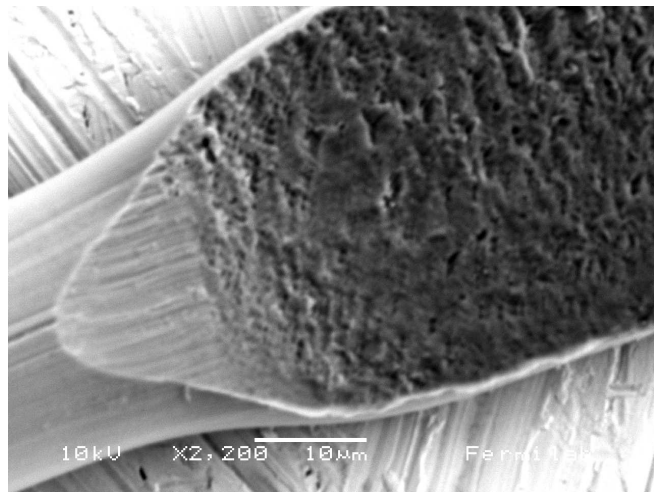


# Resonant frequencies



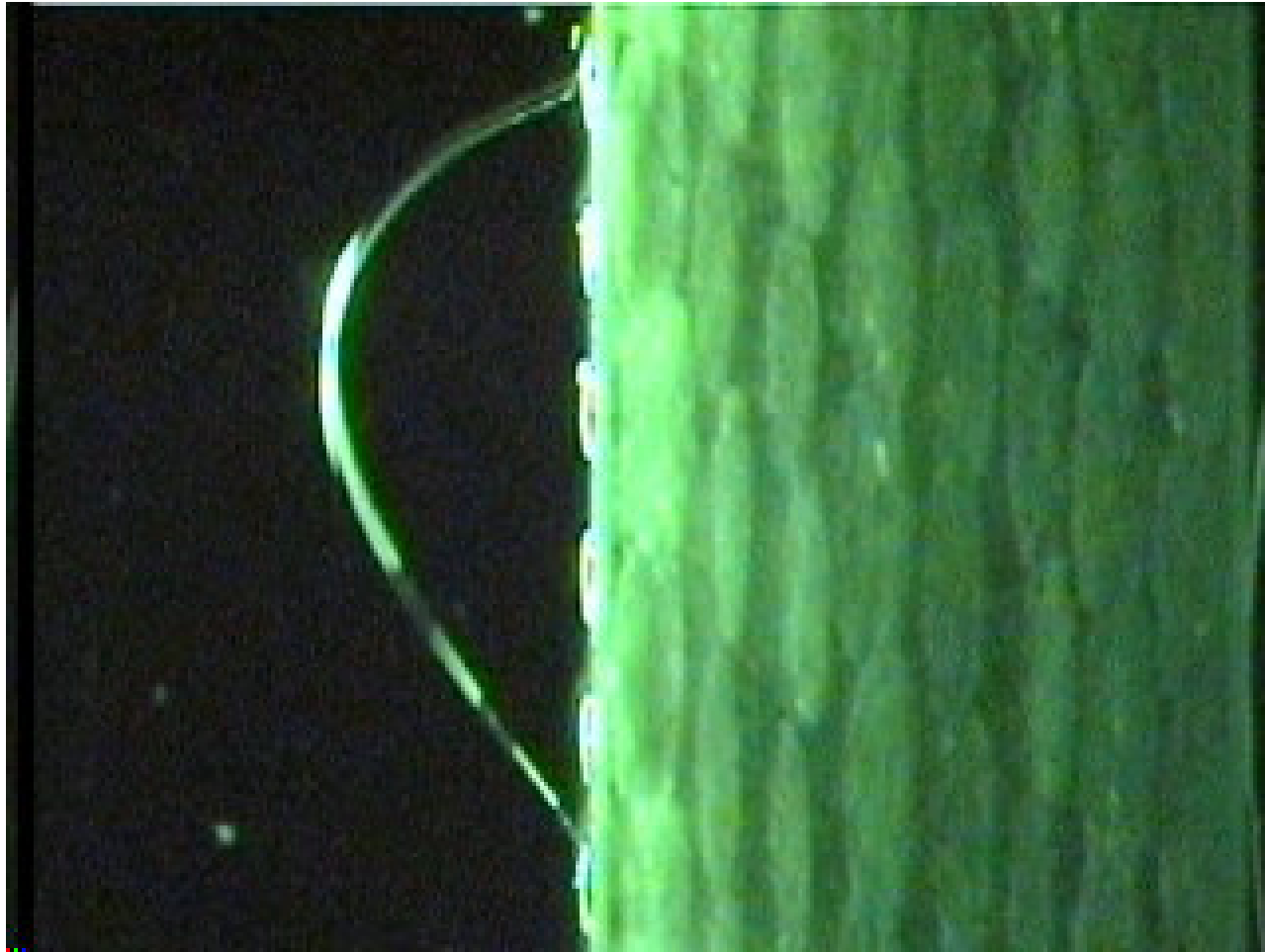


# SEM pictures taken at the T.D





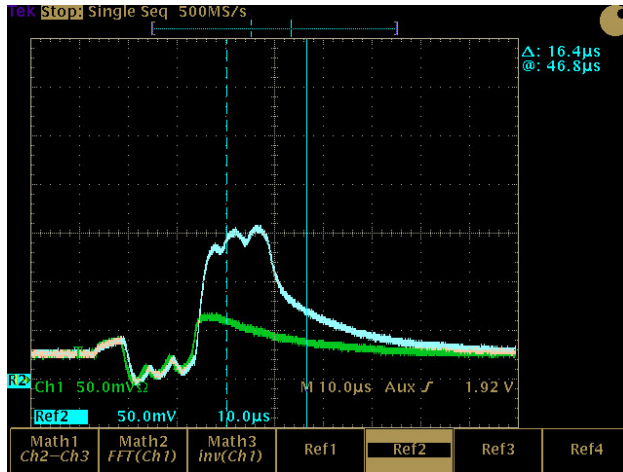
# Resonant frequencies





# The force driving the resonance

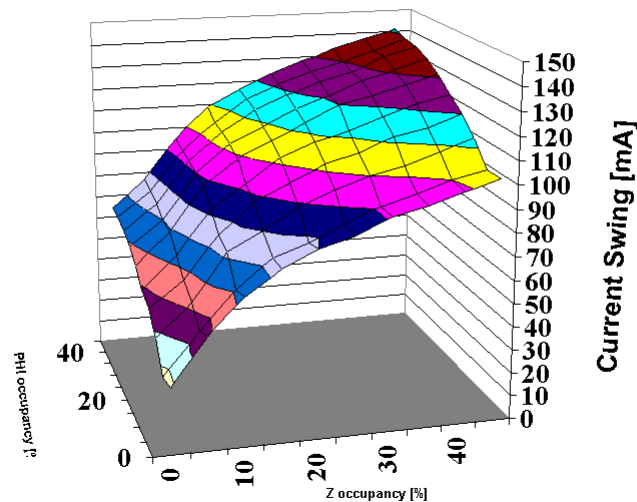
The DVDD current vs time during a L1A cycle



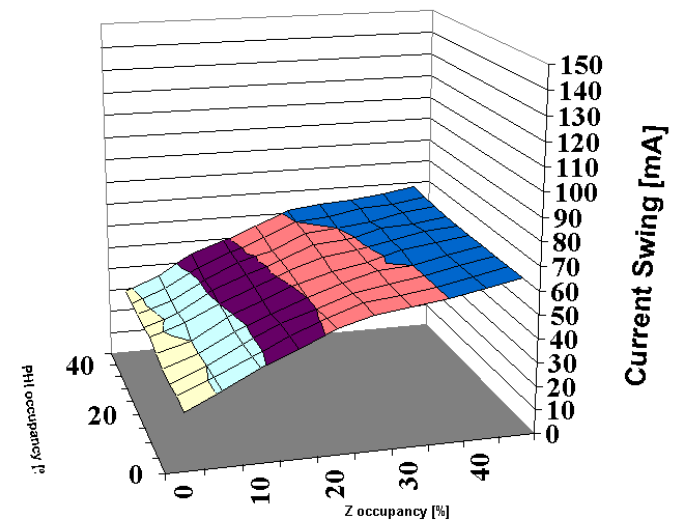
The BE of the SVX3d chips have a time dependent power consumption on the DVDD power line

- The force changes with time
- The force is strongly dependent on:
  - The R-driver settings
  - the occupancy
- To minimize the current and the current swing there is potentially a price to pay on the data quality
  - reliability of the data transmission line
  - Efficiency and resolution?

Layer 1 ladder with RDriver=7. X and Y axes are Phi and Z occupancy in percent



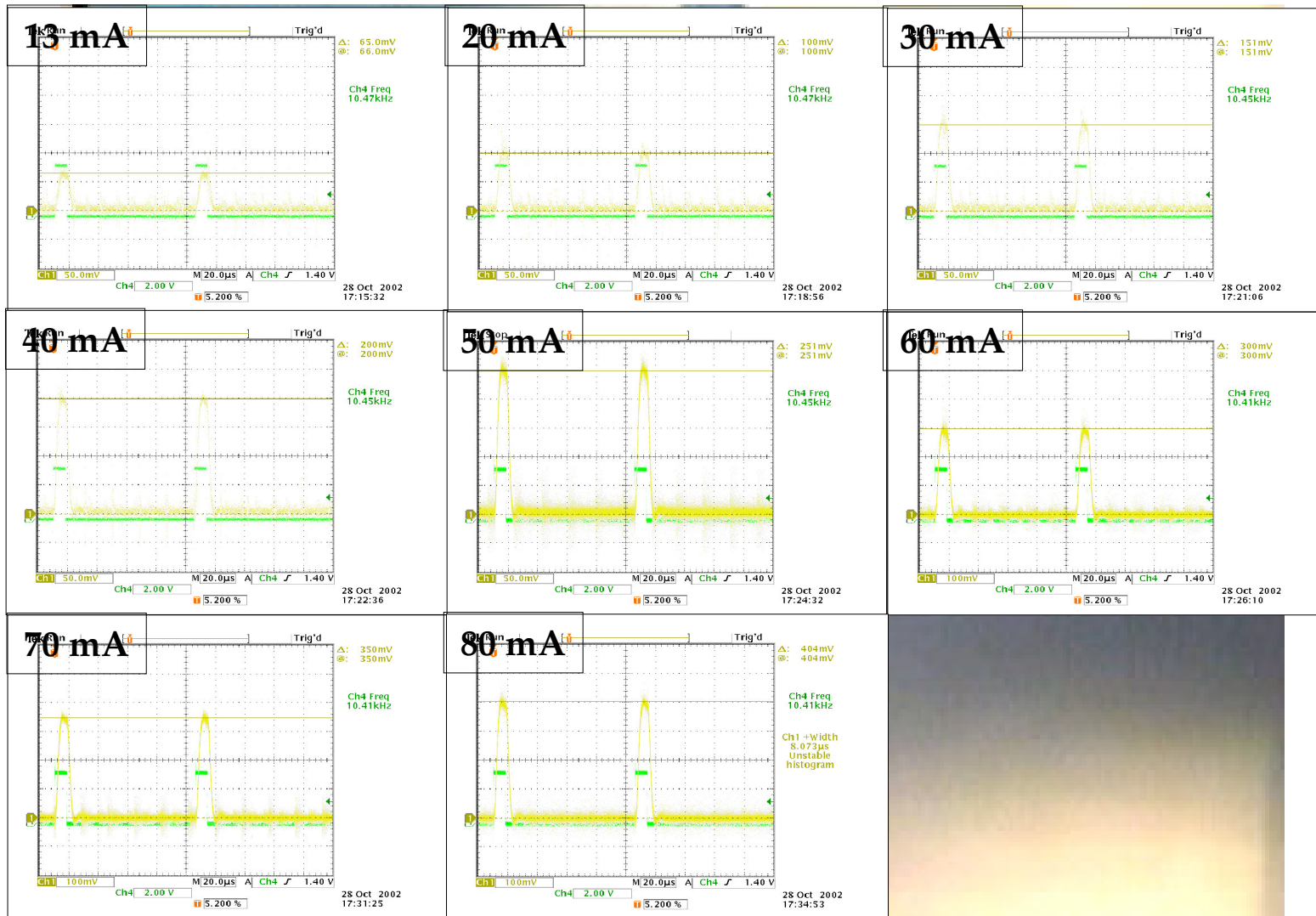
Layer 1 ladder with RDriver=1. X and Y axes are Phi and Z occupancy in percent







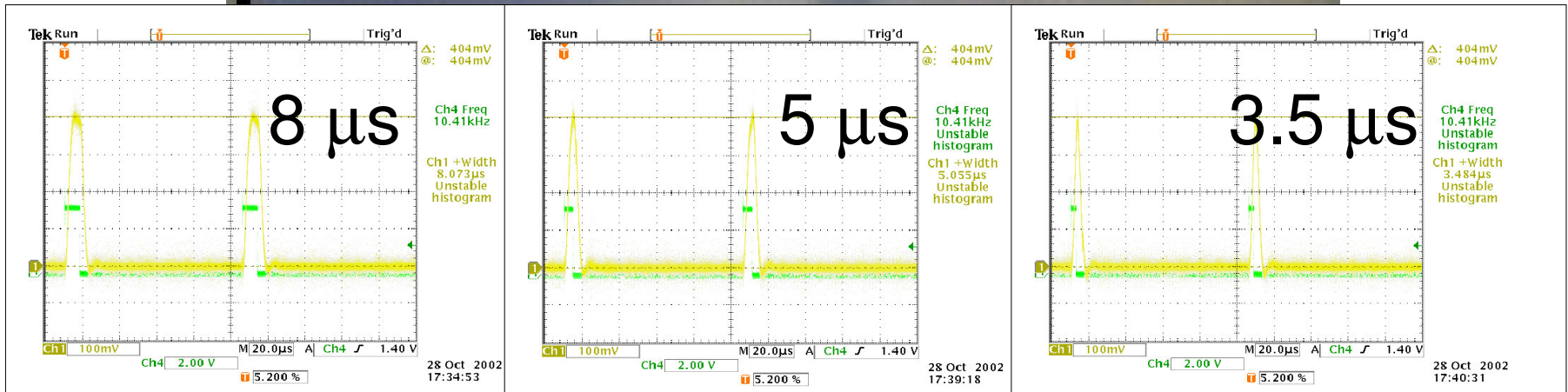
# Current - Pulse Amplitude (Rdriver)







# Current Pulse Width (Occupancy)





# Changes already done on the CDF Silicon Detector



- Changed the Rdriver settings for the SVX3d chips.

- ➔ Explored 7 to 4 and changes have been applied accordingly

- ➔ Data from 4 to 1 has been taken last night and are being analyzed

GUI Set	Real Set	Run Num	No R/O	Bad R/O	Perf. R/O
7	7	153034	42	77	1085
3	6	153039	44	78	1082
5	5	153037	48	83	1073
1	4	153044	51	80	1073

- Raised the Thresholds for SVXII from 7 to 9 ADC

- ➔ This will lower the Noise occupancy

- ➔ Shorter pulses

- ➔ Not impact on physics (to be verified)



# Plan for the future

- There are 3 parameters that play a role:
  - ➔ Current Amplitude: We are dealing with it
  - ➔ Current Pulse Width: We are dealing with it
  - ➔ FREQUENCIES: Understand if there are windows of frequencies that should be avoided
- Characterize multiple wire-bonds with the same shape as in the detector
  - ➔ Understand if there are windows of frequencies that should be avoided
  - ➔ If this is the case we will have deal with trigger and DAQ issues
- I want to have a “BRAIN STORM” meeting sometime next week
  - ➔ More/different expertise is needed:
    - ➔ Trigger expert
    - ➔ DAQ Expert
    - ➔ Whoever is interested and willing to do work!
  - ➔ Please be ready to provide your brain power and some work.



# Conclusions



## A group of people is working hard on this topic

- **There is a growing list of things to do**
  - ➔ We believe the man-power is enough but
    - ➔ **We do not want to lose anybody**
    - ➔ **We will ask for more**
- **So far successful on:**
  - ➔ Ruling out the power surge mechanisms
  - ➔ Ruling out (almost) the “aging” of the Jumper’s VIAs
  - ➔ Building a strong connection between failures and Lorentz forces
- **Fair amount of work being done to minimize the impact on CDF**
  - ➔ Minimizing DVDD current and current swing (Rdriver and Thresholds)
  - ➔ Automatic HRR called by Silicon Online monitoring tools
  - ➔ Impact of Sparse vs neighbors readout being investigated
- **Moving to the frequency domain is a new challenge and we will need more resources for 2-3 months**
- **Do NOT run tests with the Silicon in CDF without the Permission of the Silicon Expert.**
  - ➔ **Need for GROUND rules to be written up.**
- **Think about it next time (Run2b)**
  - ➔ Strongly consider replacing CPC (DOIM) for ISL
    - ➔ Buy now PARTs that could get obsolete (ELCO Connectors)
  - ➔ Review your design considering the lesson being learn
  - ➔ Is encapsulation enough? (Very likely so! Sigh!)